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Visual Vulnerability of the Landscape: Control of Visual Quality

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Cover: Natural snowslide and barren openings joined by well shaped and dispersed timber cuttings make an orderly pattern, at Meadow Cabin Creek, Bridger-Teton National Forest, Wyoming.

Visual Vulnerability of the Landscape: Control of Visual Quality

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RESEARCH SUMMARY

Visual vulnerability is the term adopted here for inherent resistance or susceptibility to degrading visual impacts. Some landscapes, more than others, can be expected to show conspicuous signs of change. Prediction of the impact of adverse effects and provision for their amelioration are necessary parts of both landscape design and environmental impact studies and are based largely on the physical, visual dimensions of the landscape. Certain landscape elements, because of their characteristics and relationships, indicate potential levels of change before specific sources of impact are known. The presence of these elements forewarns that existing wildland landscape quality may be affected in particular ways by such activities as roadbuilding, timber cutting, or transmission line location.

The elements of visual vulnerability covered here are selected physical and visual attributes of landforms and attendant surface patterns of vegetation—the vegetative mosaic. Whether proposed changes are compatible or incompatible with the landscape can first be evaluated by analyzing certain attributes of landforms. Included in this analysis are characteristics of profiles or silhouettes, different categories of surface slopes, degrees of steepness, surface visibilities related to steepness and angles of view, and effects based upon different terrain locations and edges.

Recognition of typical dimensions and proportions of local topographic relief, surface gradients, and horizontal distances between peaks or between peaks and valleys helps to define local landforms. The flatness or steepness of surface slopes directly determines the relative amounts of visible surface. The steeper the surface, the more it can display visual impacts of potential changes. Slope categories and related amounts of visibility are examined by means of a model.

Different locations on landforms can be expected to show various levels of visual vulnerability. In general, at higher locations, impacts are more obvious than at lower ones. Edges—such as skylines, water edges, and terrain ridges or lines—are also places to look for significant levels of impact display because they are sources of marked visual contrast or distinction. Midslope areas usually include the steepest parts of landforms, which have high proportions of visible surface. Because bottom ground surfaces are normally flatter than those of the higher side slope, the apparent size of objects or surfaces is reduced by perspective foreshortening. Increased screening may occur because plants and small changes in terrain elevation decrease the number or choice of effective viewing points.

Surface patterns in the landscape are those surface variations made up of differing colors, textures, shapes, and their edges. Although vegetation in its various life forms is usually the dominant element of visual pattern, it is joined by water, rock or barren surfaces, and natural or human-caused soil exposures. The combined relationships of surface materials are frequently an important source of visual distinction in the landscape. Patterns of vegetation and soils are also the first things altered by such activities as timber cutting, road construction, and mining. Because such changes are seen as disruptions of surface mosaics, estimating the degree of visual vulnerability is closely tied to observation of preexisting patterns.

Texture, in the landscape overview, can be defined as the repetition of the same or similar plant forms with a reasonably consistent spacing. Colors are described in terms of their main components: hue, value, and chroma (saturation). Texture-color contrasts are a significant source of visual impacts.

Use of the Munsell color charts for soils and vegetation for judging color value and chroma (saturation) levels and contrasts is recommended as the obvious way of comparing landscape colors. Such charts are a standard reference.

Shapes are discernible and bounded areas of consistent color and texture. Shape edges vary, however, from distinct to very indistinct. Description and representation of repeated shapes help to identify compositional elements that are visually typical of local surface patterns. When this analytical understanding has been achieved, such resource manipulations as timber cutting, type conversions, and road or power corridor alinements can be guided to fit and reflect identified surface patterns.

The visual distinction between vegetation mosaic shapes depends on their color and texture characteristics and their edges. Four different kinds of edges can be identified and ranked for their relative distinctiveness. They are butt edges, interfingered butt edges, stepped ramp or buffered edges, and gradually blended or feathered edges.

For proper use, the analytics developed here should be related to the typical landforms and surface patterns indigenous to a particular region or locality. Only in that way can more specific and reliable predictors of visual vulnerability contribute to better landscape planning, design, and management.

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INTRODUCTION

Responsible land planners are concerned about the visual impacts of human-caused changes in the landscape. Prediction of the impact of adverse effects and provision for their amelioration are necessary parts of both landscape design and environmental impact studies and are based largely on the physical, visual dimensions of the landscape. Visual vulnerability is the term adopted here for inherent resistance or susceptibility to degrading visual impacts. Some landscapes, more than others, can be expected to show conspicuous signs of change. Certain landscape elements, because of their characteristics and relationships, indicate potential levels of change before specific sources of impact are known. The presence of these elements forewarns that existing wildland landscape quality may be affected in particular ways by such activities as roadbuilding, timber cutting, or transmission line location. If the potential impact and its magnitude can be predicted, planners can avoid damage; and physical manipulations may be skilfully designed for compatibility with the surrounding landscape. Protection of existing landscape quality, whatever it may be, is presumed to be a part of any planning or management goal.

No claim is made here that the only source of visual esthetic quality in the landscape lies in its unaltered, natural state. Changes can be designed to fit comfortably into their surroundings if sufficient skill and care are used. The resulting combination of natural and artificial effects is not necessarily lacking in quality—even if observation shows some failure to achieve compatibility. In western wildlands, apparent naturalness is apt to be the dominant visual character; it is also the one that the public evidently prefers (Gallup Organization 1978). In this paper, however, the concept of visual vulnerability is based on a set of landscape characteristics existing at a given time; whether the condition is natural or a cultural modification is not a critical point.

The elements of visual vulnerability covered here are selected physical and visual attributes of landforms and attendant surface patterns of vegetation—the vegetative mosaic. Thus, not all conditions and relationships that affect the way a landscape may be altered by use of wildlands are included. Omitted, for example, are visual impact predictors in relation to water bodies, orientation (lighting), climate, and landscape compositional types (Litton 1968, 1972). Neither is there an attempt to integrate or weigh all the different elements, with their linkages, that enter into predicting severity of visual change. It should be recognized that authorities do not, at this time, agree about relative weights for different analytical or evaluative criteria for the landscape. The lack of consensus stems partly from the mixture of quantitative and qualitative criteria applied. Also, criteria that apply loosely to very large areas or regions cannot be weighed as dependably as the criteria for a specific local landscape. A single system of weighing prediction factors might seem desirable in this paper, but would be unrealistic because we are concerned here with an unspecified and generalized landscape. For regional landscapes or those typical of a particular place, an integrated system of visual impact predictors might presumably be developed, with tentative relative weights.

LANDFORM ANALYSIS

Landform represents the basic three-dimensional structure of the landscape—its backbone, surface, and space where natural processes and resource harvest such as timber cutting can be seen. Whether proposed changes are compatible or incompatible with the landscape can first be evaluated by analyzing certain attributes of landforms. Included in this analysis are characteristics of profiles or silhouettes, different categories of surface slopes, degrees of steepness, surface visibilities related to steepness and angles of view, and effects based upon different terrain locations and edges.

Silhouette or Profile Types

Visual vulnerability is tied to how the landscape looks, and the characteristics of landforms in profile indicate typical regional form. Identifying silhouette or profile types can help to:

1. Indicate places and parts of landforms where greater or lesser impacts may be expected.
2. Determine a relative degree of landform variety, one index of visual quality in which higher values imply higher priorities for landscape protection.
3. Indicate that visual impacts are more extensive on land surfaces with steeper gradients than on those with more gentle gradients.

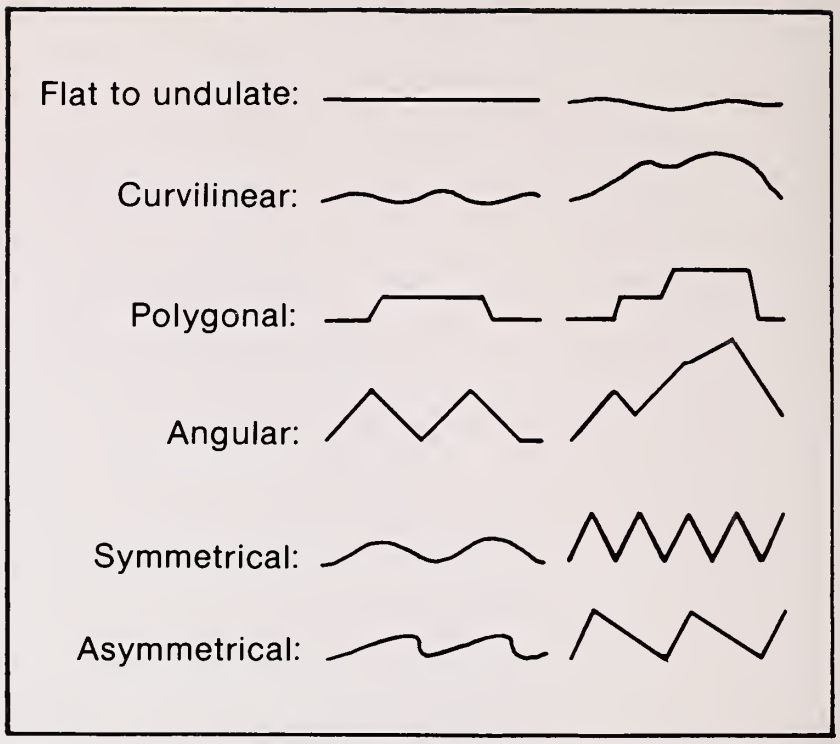

Figure 1—Four differing landform characteristics constitute basic visual types. Any combination might occur; symmetry and asymmetry are fundamental variations.

Although topographic contour maps are the source of profiles, the map itself is an abstract expression that lacks the graphic simplicity of a profile or silhouette elevation. Skylines seen in the field look much like profiles and are visually significant in our perception of landforms. Existing profile characteristics represent a graphic baseline, which may be disrupted or altered by anticipated grading changes, such as those in surface mining. Four basic form characteristics may be identified with silhouette diagrams (fig. 1). Almost any combination of these silhouettes may

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Figure 2—Symmetrical low hills commonly dot the unglaciated Missouri plateau landscape. (Powder River, Mont.)

be found. A basic variation is that of symmetry or asymmetry. Examples from the landscape are seen in figure 2 and figure 3.

Analyzing Profiles

Recognition of typical dimensions and proportions of local topographic relief, surface gradients, and horizontal distances between peaks or between peaks and valleys helps to define local landforms. The several silhouette diagrams shown in figure 1 and representative photographs can be analyzed first for some of their generalized visual characteristics, as a preliminary to determining what sources of degradation should be anticipated. In particular, the amount of surface revealed, and thus subject to change, can be noted.

The flat-to-undulate plane (fig. 4) is essentially continuous. Because of marked perspective foreshortening associated with a gentle slope, only a very small proportion of a flat surface is visible as compared to its plane area. Addition of vertical elements or changes in existing verticals interrupt the continuity by contrast. Nearness, scale, number, disposition, and form of these verticals are the elements that determine whether potential visual change will degrade or enhance. On a flat plane, verticals may have the strong contrast of skyline images.

The curvilinear profile of a more mature landscape (fig. 5) also shows continuity, but consists of three connected parts: top or ridge with its transition, side slope, and bottom with its transition. Proportionally, the largest revealed surface where impacts may occur is in the side slope segment. At the ridge (or shoulder), impacts are displayed against the skyline with potentially conspicuous effect.

Polygonal landforms, exemplified by mesas (fig. 6), break into three sharply distinctive profile parts: an isolated top plane, a nearly vertical side slope with angular buttress, and a somewhat separated base. Maximum surface is revealed on side slopes; some transition to the base plane is likely. The table top surface is invisible from below, but its contour edge is the sky silhouette that distinguishes the visual image of the whole form.

An angular profile, typical of mountains (fig. 7), has two dominant parts: the steep face plane and the base with transition. Bottom flats such as glaciated valleys, if present, are apt to be relatively narrow and visually subordinate to the ascendant slopes above them. The ridge is a skyline edge made by the two opposing side slopes and lacks significant lateral width; it is a thin and fragile line. If we assume that side slopes are of maximum steepness in angular forms, then proportionally more surface area is visible than on the slopes of curvilinear hill forms. Talus slopes of 60 percent and steeper gradients can make up conspicuous and relatively large parts of the side slope facade. The base plane and transition at the toe of the talus are only a small part of the whole visual surface.

Consideration of profile characteristics according to the proportional parts (fig. 8) allows more precise visual analysis. General observations may be made about these parts, and detail and specific visual data may be added for regionally characteristic forms.

At ridge or skyline, maximum contrast is seen between terrain and sky. Disruption of the skyline continuity is most likely to cause degradation. There is high visibility at this edge unless the ridge is flat enough for the shoulder to act as a screen to the true ridge. Screening is also increased

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Figure 3—Asymmetrical low hills form a transition between the Middle Rocky Mountains and the Wyoming Basin. (Kemmerer, Wyo.)

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Figure 4—Flat-undulate landforms typify the extensive and common landscape of the Northern Great Plains. (Amidon, N. D.)

F-533362

Figure 5—Curvilinear hills of low to medium height are the usual landforms of the coastal range in California, near Tomales Bay.

when more acute angles of sight originate from the side slope or low down at the beginning of the bottom transition. The ridge transition face or facade is a relatively small part of the whole profile face. Perspective foreshortening of the ridge and its transition area causes surface disturbances to be visually diminished. Ridge flattening from erosion suggests a stable site area, thin soils, and reduced likelihood of the visual impacts of land slippage.

The side slope, the steepest part of the profile, has maximum surface visibility and normally represents the largest visible part of the whole profile. Any access routes are highly visible if vegetation is scant or if disturbed soils are light in color value. Areas or elements of human-caused change seen against the background of the original surface normally have less contrast than those seen on the skyline. In the Pacific Northwest, however, clearcuttings, for example, with dark surrounding forest and light soils, can present a more difficult and more extensive problem of visual contrast than do changes at the skyline (Walters 1980). Soil development is probably greater on the slope

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Figure 6—Polygonal landforms, butte or mesa forms, are conspicuous for contrast to their base plane. (Starvation Butte, Mont.)

than on the ridge, and therefore vegetative cover—in areas of amenable climate—may provide visual screening. Any soil disturbance has maximum visibility because of revealed surface area. Side-slope instability is apt to be at a maximum, compared to other parts of the profile, increasing the potential for surface disruption from movement.

The bottom flat and its transition area, when viewed in elevation, normally present a smaller visual surface than the side slope. Here, as on the ridge, perspective foreshortening reduces the apparent surface. Deeper and more productive soils, if adequate moisture is available, suggest maximum growth potential for vegetation and the screening it provides. In some western climates, however, forest growth is commonly concentrated on higher, or northerly and more moist slopes, while grass and scrub occupy drier bottom flats. There is little likelihood of the visual disruption of land slippage on the flat as compared to side slopes. Even so, the bottom is most attractive for development, clearing, and change, potentially countering, from a visual standpoint, the advantages of flatter terrain and heavy vegetation that may be present.

Comparing and Ranking Regional Profiles

Sample profiles, representing typical regional landform characteristics, can be compared for relative differences in variety—one criterion for visual quality—and for slope gradient categories—one criterion for relative variety and visibility.

On the basis of these two landform characteristics, the regional profile samples can be ranked for visual vulnerability. More profile complexity, more variations in relative relief and in categories of steepness, and marked local relief are all indicative of higher landscape quality where greater visual vulnerability can be expected. The steeper landform

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Figure 7—Angular landforms reinforced with angular scree slopes and peaks typify high mountain landscapes. (White Cloud Mountains, Idaho)

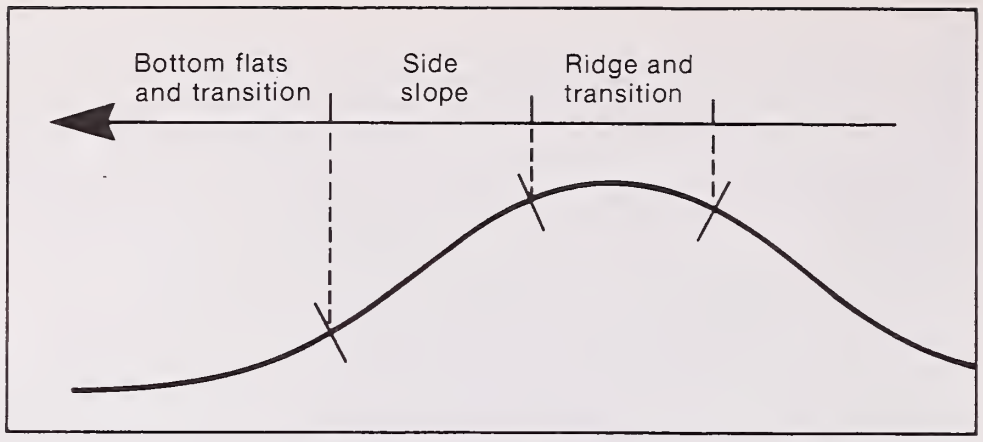

Figure 8—Proportional parts of landform defined by generalized changes of profile form and slope.

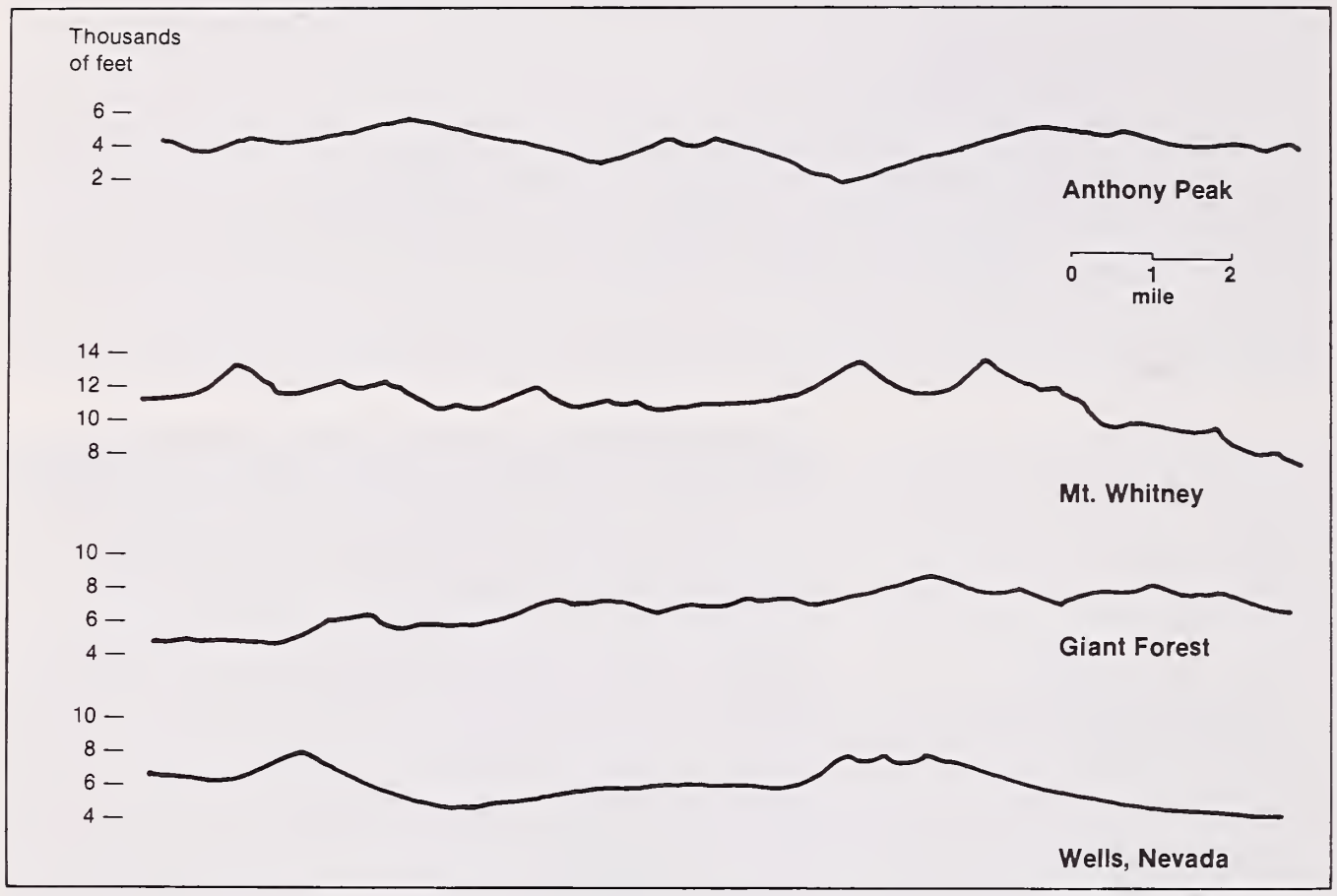

Figure 9—Four different regional profiles demonstrate contrasts of form variation and slope characteristics. Steeper slopes imply greater visual vulnerability to impacts and greater visual distinction.

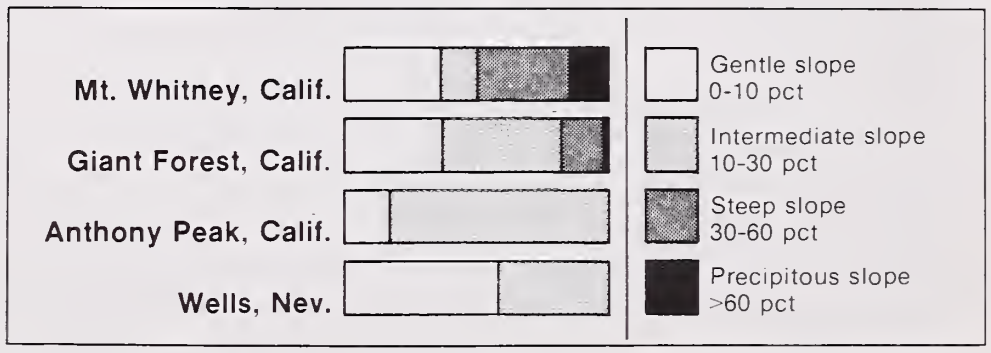

Figure 10—Gradient categories (gentle, intermediate, steep, and precipitous) are compared from regional profile examples. More variety and more steepness are equated to greater visual distinction.

faces are, the more visible surface they have as compared to gentler slopes—hence their greater vulnerability to visual impacts. Analysis of regional profile samples is a means of using simple measurements to make methodical comparisons. This same kind of ranking comparison may also be made at a more detailed scale within localities of a single landscape region.

As an example of how comparisons are made, four regional profiles—Anthony Peak, Mount Whitney, Giant Forest, all in California; and Wells, Nev.—were selected (fig. 9). The profiles are based upon 1:24,000 scale U.S. Geological Survey topographic maps. Distances between peaks and ridges are indicated, along with the number of peaks and the amount of local relative relief. Profile lengths are equal for purposes of comparison. Slope analysis uses the four categories discussed later under the heading "Surface Slope Categories;" these are measured and calculated from the profiles (fig. 10).

Table 1—*Characteristics of landform of four regional profile samples used to rank visual vulnerability*

Landform characteristics	California			Nevada
	Anthony Peak	Mount Whitney	Giant Forest	Wells
Number of peaks	8	10	8	4
Distances between peaks and ridges ..... Miles	3 to 4	1½ to 4	2 to 3	5 to 9
Relative relief ..... Feet	2,000 to 3,500	1,000 to 2,500[1]	Up to 2,000	1,500 to 3,000
Profile in gradient categories:				
Ridge, transition				
Gentle: ..... Pct	11	4	10	3
Side slopes				
Intermediate ..... Pct	84	14	45	43
Steep ..... Pct	0	35	16	0
Precipitous ..... Pct	0	16	7	0
Totals	84	65	2	43
Bottom flats and transition:				
Gentle ..... Pct	5	31	27	54
Maximum gradient	27	90	75	30

[1]West: to 6,000 feet for east.

The profiles may be examined directly for the visual variations they represent, but more methodical comparisons may be made from calculated slope analysis. Other interpreted information may also be derived, such as relative relief, flat-steep proportions, peak form types, or peak-valley spacings (table 1). To analyze the landform profiles for relative visual vulnerability, two assumptions must be made. The first is that greater variation suggests a landscape of more visual interest or one of higher scenic quality—a condition that, in turn, carries an assumption that high priority will be given to protection of that quality. This is a broad generalization and applies only to variation in landform. The second assumption is that landscapes with proportionally more and steeper side slopes will present relatively greater amounts of surface visible to the observer. The discussion of "Surface Visibility" demonstrates the validity of this second assumption.

Comparison of four sample regional profiles is essentially based on landform variation and surface visibility. Greater ranking weight is given to those profiles which demonstrate the following characteristics:

1. Those having proportionally more steep slopes—hence, with greater surface visibility.
2. Those having a greater variety of different slopes.
3. Those having greater relative relief and steepest slopes.
4. Those having more peaks.

The preceding four landform profiles have been ranked, least to greatest, for visual vulnerability. See table 1 for summary of ranking data.

1. Wells, Nev.
2. Anthony Peak.
3. Giant Forest.
4. Mt. Whitney.

Surface Slope Categories

As indicated in the discussion of landscape profiles, the flatness or steepness of surface slopes directly determines the relative amounts of visible surface. The steeper the surface, the more it can display visual impacts of potential changes.

Surface slopes, usually expressed as percent gradients, vary between flat and vertical. It is convenient to divide slopes into working categories according to possible use, access, visibility, or potential impact. Different authorities, depending on their purposes, make and recommend different slope categories. Landscape architects and other designers, in considering project design and site planning, have been primarily concerned with the use of gentler, rather than steeper, terrain. Regional topographic characteristics may have an influence—what are called steep slopes in the Rocky Mountains are probably quite different from steep slopes in the Great Plains. Eckbo (1950) notes these slope divisions for project design: Flat, 0 to 4 percent gradient; gentle, 4 to 10 percent; steep, 10 percent and above. For generalized site planning, Lynch (1971) identifies slope classes of flat, easy, and steep according to potential intensity of use and ease of movement, but he does not suggest gradient categories.

Forest and resource management requires activities on very steep terrain, as well as on those more moderate slopes typical for project development. A set of four arbitrary slope classes may be identified accordingly: Gentle, 0 to 10 percent; intermediate, 10 to 30 percent; steep, 30 to 60 percent; precipitous, 60 to 100 percent and above—up to vertical. The class divisions are considered arbitrary because there is no precise basis for their limits; nonetheless they reflect values for such things as walking, vehicular

capability, or repose angles of soils and other materials. Some of the natural and utilitarian constraints associated with the slope classes are shown in figure 11.

Surface Visibility

The steeper a slope, the greater is its proportion of visible surface. Greater steepness also has potential for increased visual disruption from such activities as grading, equipment use, or timber cutting. Slope categories and related amounts of visibility are best examined by means of a model. Photographs of a model are useful to measure relative differences of visible surface revealed on different slopes. Different angles of view also serve to demonstrate consequent differences of visible surface.

To illustrate this method, a photographic model was made at 1:2,400 scale. A white circle representing an area 3,000 feet in diameter, equal to 160 acres, was photographed against a middle gray background. Photographs were made on four selected slopes: gentle (5 percent), intermediate (16 percent), steep (38 percent) and precipitous (75 percent). For each slope, the circular area was photographed from four angles of view: an ascendant angle of 10 degrees, a level line of sight, and depressed angles of 10 degrees and 20 degrees, respectively. The line of sight was at the midpoint of the circle. The distance from circle to camera represented 1.7 scale miles.

Results of the photographic representations are shown in figure 12 and figure 13, and table 2. The visible proportions of the surfaces are given as percentages of the model circle seen in plan view. Additionally, to give some notion of what is represented by a 10- or 20-degree angle of sight, table 3 relates the height of eye (in feet) to the horizontal distance from the observer to a visible object, using 10- and 20-degree sight lines.

One additional modification of the visible images of the model might be made to account for diminution of the surface according to change of angle. That is, the model

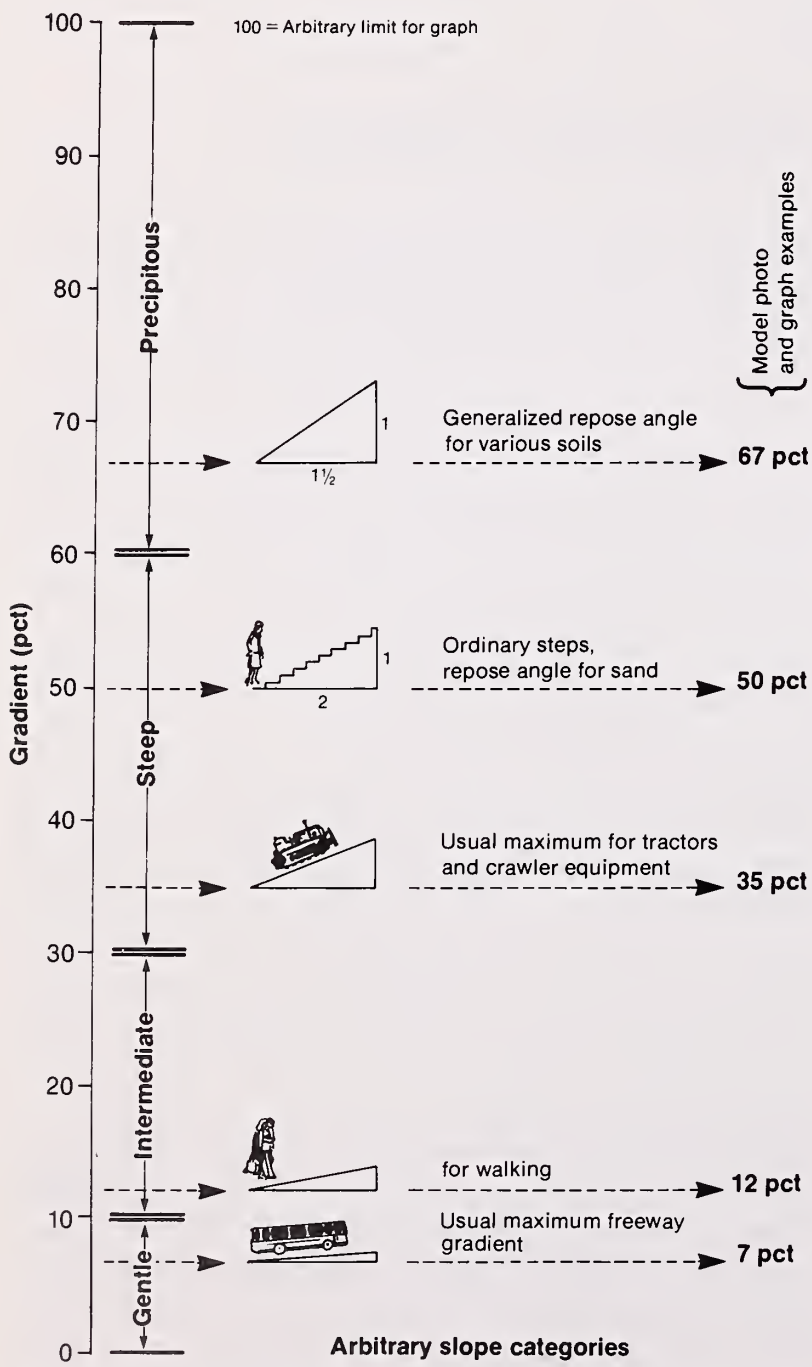

Figure 11—Slope categories (gentle, intermediate, steep, and precipitous) are based on use limitations and repose angles of some materials, but have arbitrary ranges.

Table 2—*Relative visibility*[1] *at four slope categories, by angle of view*

Angle of view	Slope category: Gentle (5 pct)	Intermediate (16 pct)	Steep (38 pct)	Precipitous (75 pct)
	Percent			
+10°	0	0	18	41
0°	6	18	38	62
-10°	22	35	51	73
-20°	35	46	59	78

[1]Based on model photography in which the plan view = 100 percent visible. (See fig. 12.)

Table 3—*Height and distance relationships for viewing angles of 10° and 20°*

Line of sight	Horizontal distance to objective	Height above or below objective
	Miles	*Feet*
10°	¼	230
	½	465
	1	930
	2	1860
	3	2790
	4	3720
	5	4650
20°	¼	480
	½	960
	1	1960
	2	3840
	3	5760
	4	7680
	5	9600

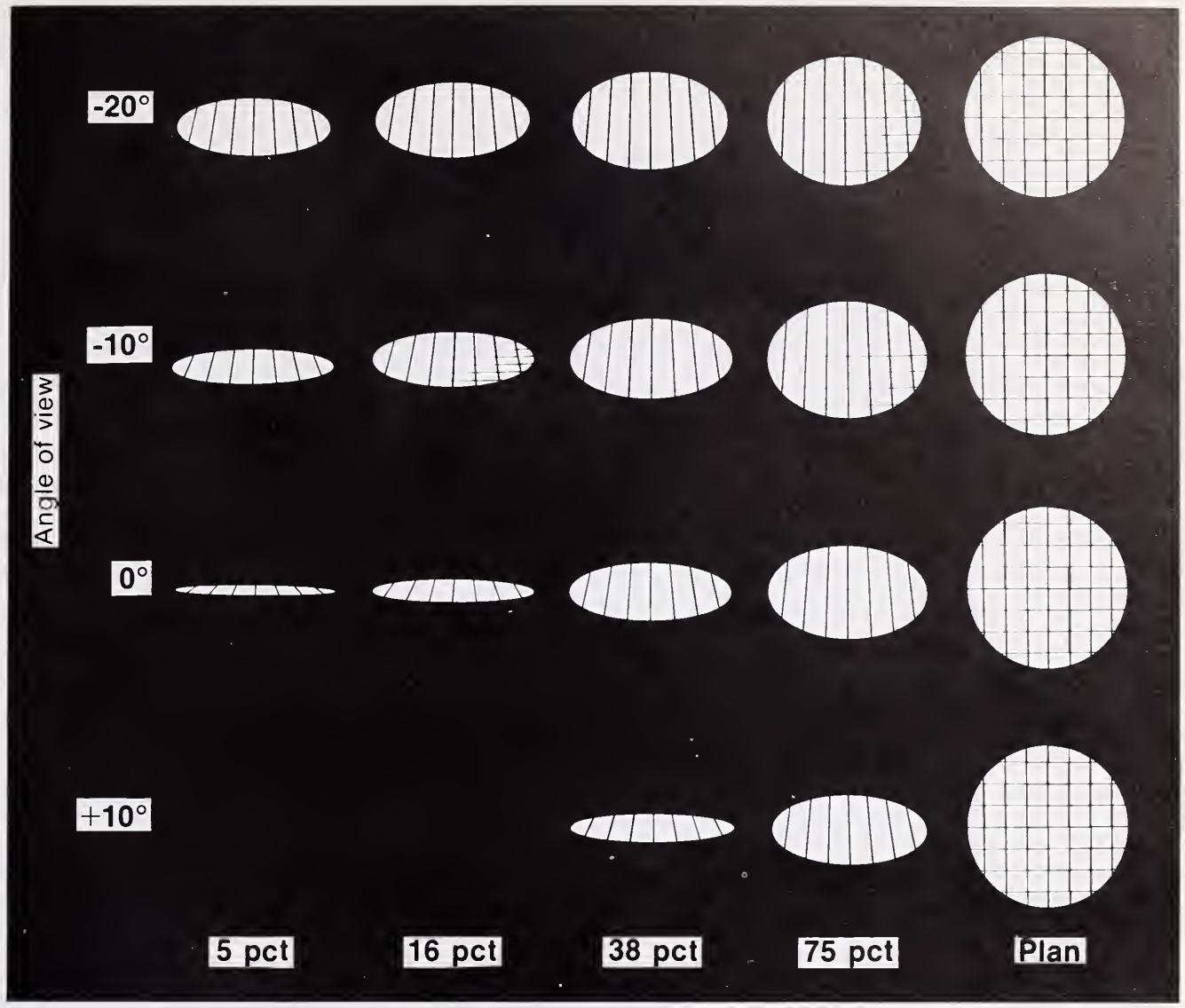

Figure 12—Relative visible surface of a circular area is perspectively affected by slope and observer's angle of sight. Model photography compares plan view to perspective views.

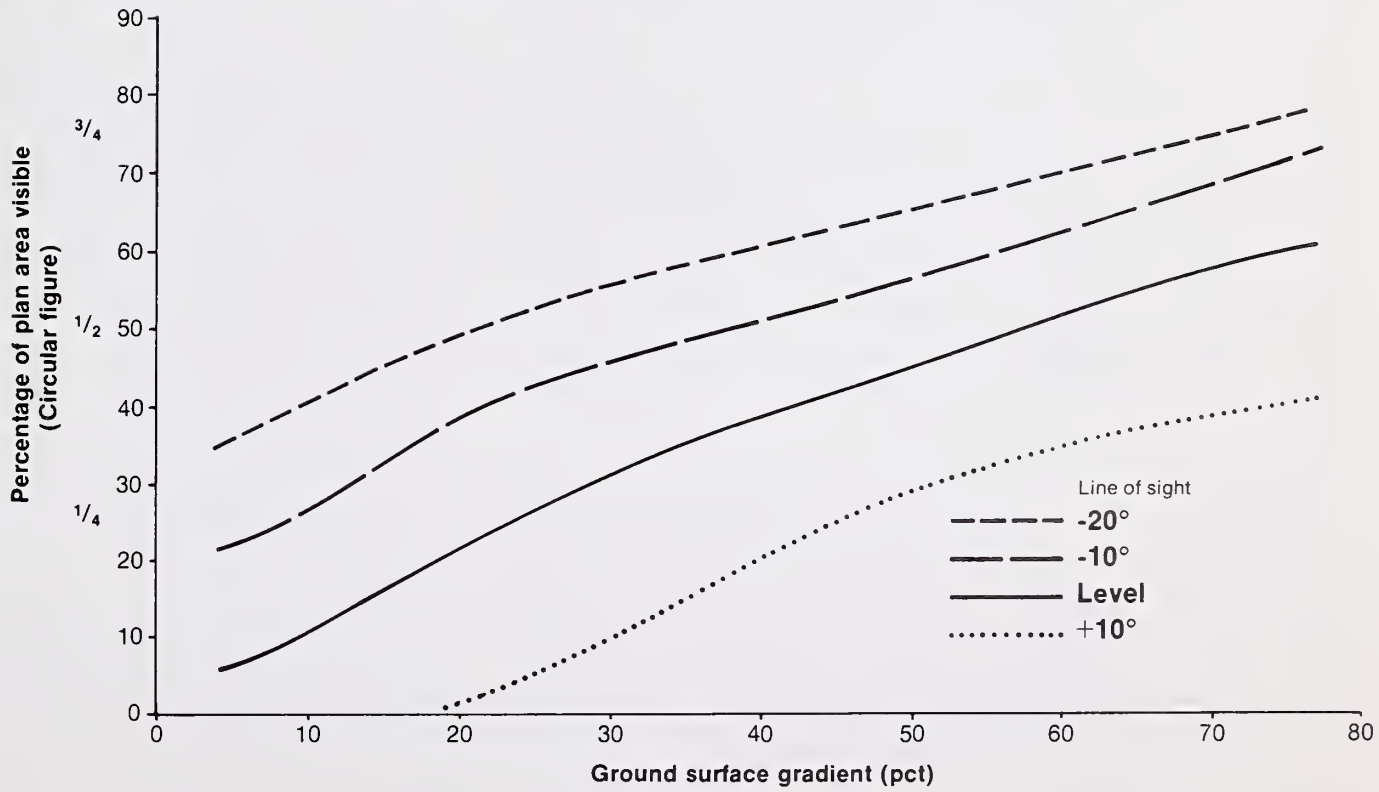

Figure 13—Model photography of circular figure is graphed to compare plan visibility with perspective visibility on selected slopes and angles of sight.

photography is based on a plane perpendicular to the observer so that the horizontal axis of the circle or ellipse is of constant length for each view. When the land plane lies at an angle from the observer's line of sight, an estimate of diminution may be obtained by applying the trigonometric function of the cosine. Although this assumes that the observer is at infinity rather than at a finite distance, the diagrams and table in figure 14 suggest the magnitude of image reduction for angular displacements.

The graph (fig. 13) comparing test shapes according to slopes and lines of sight represents a continuum from which relative visibility estimates applicable to an area of

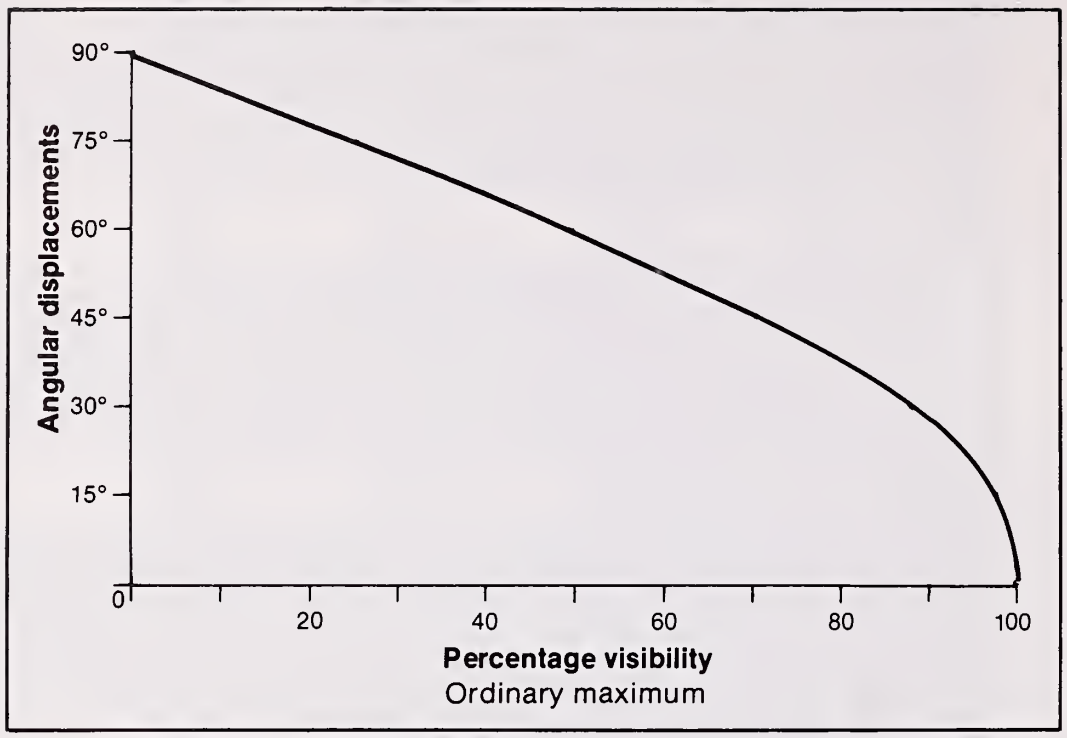

Figure 14—Trigonometric cosine function may be used to estimate diminution of visible axis width due to angular displacement of surface. If surface is at 45 degrees to line of sight, for example, then image width is reduced 30 percent compared to head-on view (surface perpendicular to sight line).

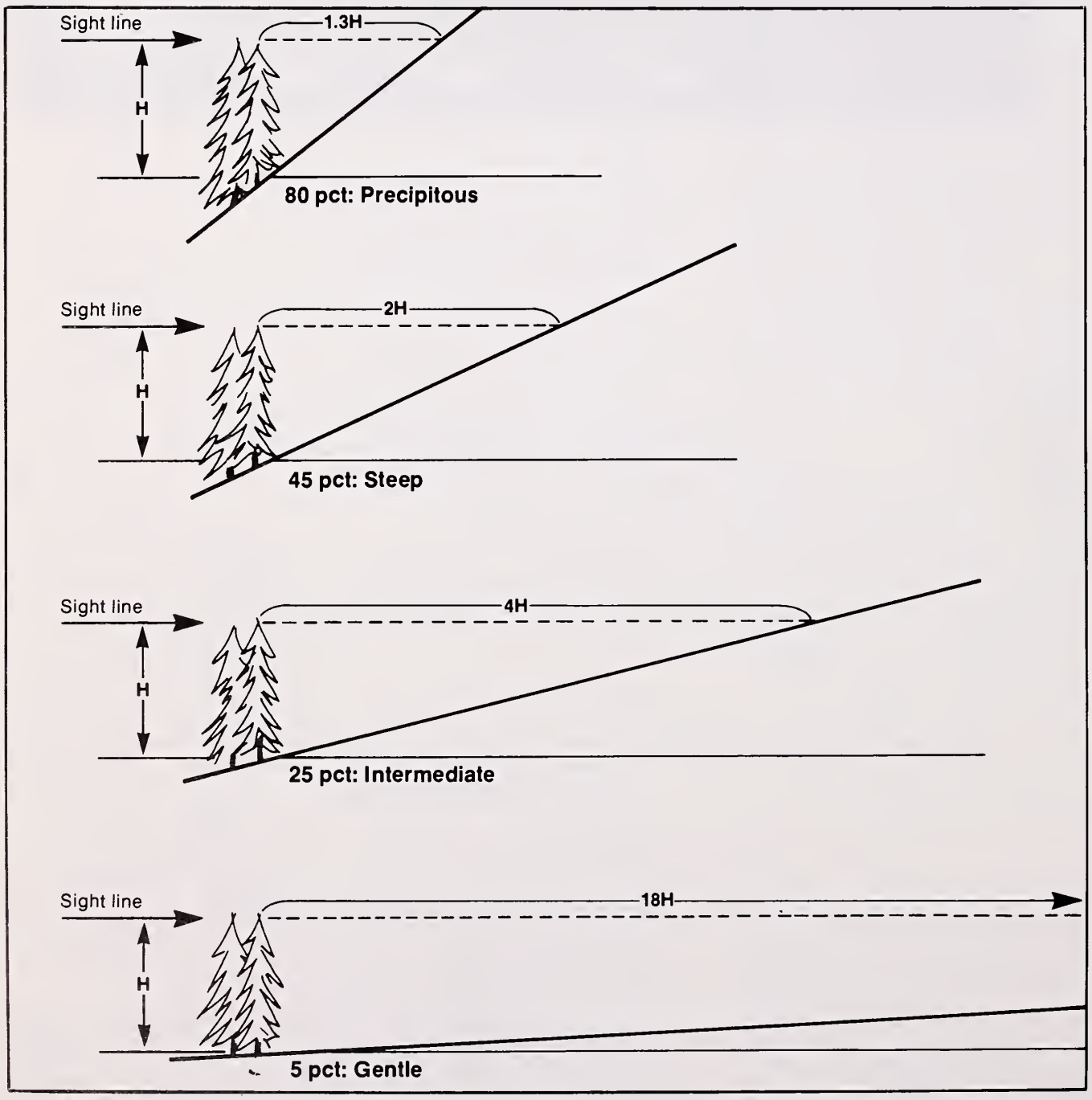

Figure 15—Magnitude of screening may be estimated for various slopes, gentle to precipitous, for known heights of vegetation or other barriers.

impact may be read. For example, interpolating on the graph, we find that for a 5-degree line of sight towards an area on a 45 percent slope (steep category), about 50 percent of the area length would be visible. Further, if the image were on a land plane rotated 30 degrees to or from a normal (perpendicular) line of sight, there would be an additional reduction in image length of approximately 23 percent (fig. 14). Visual impact prediction would be an application of this kind of information. Note that the simple shape and simple planes used in the experiment are more completely visible than would be expected with the surface irregularities of real projects in a real landscape. No vegetative or terrain screening is shown, for example. To illustrate this effect and to account for it, tree screening on four selected slopes of differing steepness is diagramed in figure 15. Thus, the model representations are conservative, indicating greater visibilities than would be expected in reality.

Landform Locations and Edges

Different locations on landforms can be expected to be visually vulnerable at various levels. In general, at higher locations, impacts are more obvious than at lower ones. Edges—such as skylines, water edges, and terrain ridges or lines—are also places to look for significant levels of impact display because they are sources of marked visual contrast or distinction. Locations (defined as areas) and edges (defined as lines) may often be joined together. However, the two are not the same, and they warrant separate consideration.

Dividing a hill landform profile into three elevational segments is a diagrammatic way of specifying high, middle, and low locations within the landscape. The rationale for division is based upon (1) the ridge and its transition with the side slope, (2) a side slope segment with a predominant or characteristic slope, and (3) a bottom transition between side slope and bottom depositional flat (fig. 16). In precipitous mountain terrain where there may be little or no transition between side slope and ridge, the upper quarter or third of the whole side slope may be arbitrarily designated as a high location; the low location may be arbitrarily the lowest quarter or may be coincident with slope transition, if present.

High locations in the landscape have greater visibility than low ones because they can be seen from more viewpoints and from greater distances. Vegetation screening also becomes less effective because distances are greater between highs on separate ridges. In any locality, there is a likelihood that peaks and ridges will be rather closely related to others of similar elevations. A random example in the northern California Coast Range, the Pickett Peak quadrangle (15-minute, 1:62,500 scale USGS topographic map), shows 76 peaks, of which 26 percent are between 3,000 and 3,900 feet in elevation, 62 percent are between 4,000 and 4,900 feet in elevation, and 11 percent are between 5,100 and 5,800 feet in elevation; there is a single peak at 6,100 feet. Also, in this area of about 235 square miles, alluvial bottoms associated with perennial streams vary in elevation from 1,600 to 3,500 feet, but the flats lie predominantly between 2,500 and 3,000 feet. Relative relief in this area, then, is predominantly between 1,500 and 2,000 feet. Figure 17 is a pictorial example of ridge elevation consistency. With peaks and ridges of similar heights, lower slopes will be largely screened by intervening ridges and only the uppermost parts of terrain will be seen.

Because the skyline edge of terrain (or vegetation that meets the sky) is normally the strongest color value contrast seen in the landscape, high locations automatically attract attention (fig. 18). Nevertheless, another condition can sometimes exist, whereby the flattened slope of a ridge can either create a shoulder that hides an area beyond it or cause perspective foreshortening that diminishes visible surface.

Middle locations, the surfaces of landforms between ridge and bottom transition areas, lose some of their visual distinction because of disassociation from both skylines and waterlines. Compared to high locations, they are apt to be visible from a reduced number of viewing stations, and there is increased potential for screening by either vegetation or intervening terrain. Midslope areas usually include the steepest parts of landforms, which have high proportions of visible surface. Although steeper slopes reveal proportionally larger surfaces to the observer, the levels of contrast are limited to texture and color contrasts of the surfaces. The maximum contrast due to surface changes, such as vegetation clearing or soil disturbance, approximates the difference in color and texture between grassland and upland forest (fig. 19). Though conspicuous, this is not the consistent and maximum contrast found at the skyline. Also, temporary contrast softening may occur on some exposures (especially northeast to northwest orientations) because of shading or backlighting.

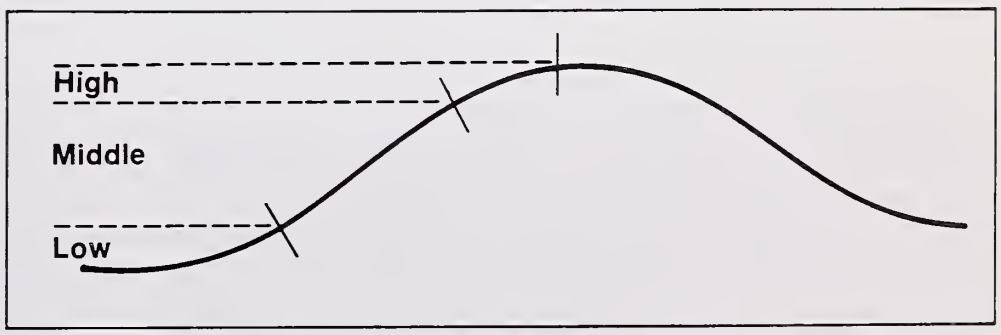

Figure 16—Elevational locations of landform are based on the side slope and its top and bottom transition areas.

F-501089

Figure 17—General consistency of ridge and peak elevations is usual for any given part of a physiographic section—a Middle Rocky Mountains example. (Caribou National Forest, Idaho)

F-533380

Figure 18—A timber cut is made conspicuous because of skyline and geometric contrasts, high location, and a water relationship. (Lookout Reservoir, Oreg.)

Terrain edges (seen as lines) of middle elevation locations are the ridges below the skyline. They may be more apparent where concentrated, as in a set of converging lines of overlapping spurs or where differences between a ridge and its background are emphasized by changes of surface cover. Modifications in visibility also result from lighting, atmosphere, distance, and exposure—conditions to be recognized and given attention for specific sites (fig. 20).

Low locations have a potential for reduced visibility compared to higher positions. Because bottom ground surfaces are normally flatter than those of the higher side slope, the apparent size of objects or surfaces is reduced by

F-533364

Figure 19—Contrasts between forest and grasslands colors and textures create a strong visual image. (Black Hills, Wyo.)

F-533365

Figure 20—Timber cuttings have low to moderate visual effects on gentle slopes and in low to middle terrain locations. (Spread Creek, Teton National Forest, Wyo.)

perspective foreshortening; sight lines are apt to be virtually level or nearly parallel to the surface being observed. Increased screening may occur because plants and small changes in terrain elevation decrease the number or choice of effective viewing points. Viewing distances are shortened, resulting in emphasis of details rather than more comprehensive views of surroundings. Although closeup views are critical in showing details, they can only provide a fragmented impression of how manipulative changes may fit in the larger landscape. That is, close-in views of an object or shape may give little indication of the visual relationships made with broader patterns of terrain and vegetation.

Water edges and margins of water bodies encountered in low-lying places are second only to skylines in potential for visual contrasts of color and texture (fig. 18 and fig. 21). Water surfaces resemble sky in their brightness, reflectiveness, and the liveliness of continuous change. Though rare in most landscapes, water is a source of amenity. A straight reach of water seen along its axis also directs attention to a

conspicuous focal terminus—a highly vulnerable spot (Litton 1968). The presence of water also enriches the scene through riparian vegetation, with its plants and trees that are characteristically lighter and brighter in color than their more somber upland associates. This difference normally holds through all seasons (fig. 22). In consequence, the water edge zone is highly vulnerable because there is comparatively little of it; it provides strong color and texture contrasts and makes focal arrangements. The water itself acts as a visual and esthetic magnet.

The visual vulnerability of landforms, making up the hard, three-dimensional framework of the landscape, may be summarized before we consider surface patterns such as the vegetative mosaic. Landform profile examples can be identified and classified and the differing levels of vulnerability they imply can be identified. For more discriminating prediction of vulnerability, typical landforms of a particular locality or region must be identified. Surface slopes may be arbitrarily divided into gentle, intermediate, steep, and precipitous classes, each relatable to different potential levels of visual impact. Surface visibility ties directly into the slope classes and is examined by use of model photography. Different elevational segments of landforms (high, medium, and low locations) and their significant edges have been discussed in relation to greater or lesser anticipated visual vulnerability.

F-484617

Figure 21—Water surface and riparian vegetation provide strong contrast to upland forest. The straight reach directs the eye to a sensitive focal area. (Uncompaghre National Forest, Colo.)

F-533366

Figure 22—The winter aspect of a riparian gallery forest against pinyon-juniper woodlands shows moderate visual contrast. (Oak Creek, Sedona, Ariz.)

SURFACE PATTERNS

Surface patterns in the landscape are those surface variations made up of differing colors, textures, shapes, and their edges. Although vegetation in its various life forms (Kuchler 1964) is usually the dominant element of visual pattern, it is joined by water, rock or barren surfaces, and natural or human-caused soil exposures. The combined relationships of surface materials are frequently an important source of visual distinction in the landscape, calling attention to particular parts and locations of landforms or enriching features and enclosures. Patterns of vegetation and soils are also the first things altered by such activities as timber cutting, road and power line construction, and mining. Because such changes are seen as disruptions of surface mosaics, estimating the degree of visual vulnerability is closely tied to observation of preexisting patterns. Making resource manipulation changes compatible with local surface patterns also becomes a primary means of reducing visual impacts.

Landscape mosaics—another name for surface patterns—come in an infinite variety of component proportions, shapes, edges, color-texture contrasts, and levels of complexity. Yet it is to be expected that there will be a local norm for patterns and a limited variation for the patterns of a larger region. Attention to some of the elements of the landscape mosaic follows.

Texture, Color, and Distance

Texture, in the landscape overview, can be defined as the repetition of the same or similar plant forms with a reasonably consistent spacing. An example is the texture of a western conifer forest stand of a single species, one age class, and 100 percent canopy cover (fig. 23). Seasonal change would bring virtually no textural or color variation to such a forest except for the flush of spring growth. In a related example, an eastern hardwood forest (fig. 24) gives a sense of consistent texture even though there are several species of both hardwood and coniferous trees in various age classes present. The unity of this summer scene would give way to considerable variation in fall or winter. Coloration and leaf drop would bring both color and texture changes to what would then be more properly described as "winter pattern," which is distinctly different from the summer texture.

Color is the visual phenomenon by which particular wavelengths of light are sensed as the colors we commonly describe by name. Colors are more accurately described in terms of two major components: *hue,* the named characteristic, such as green or greenish, and *value* (or brilliance), the darkness or lightness, that is, the resemblance to black, white, or a shade of gray. The additional characteristic of *saturation* (or chroma) describes chromatic vividness or purity of hue. Accordingly, as an example of how to make an application to the landscape, a particular stand of conifers could be described as muted yellowish green in hue, very dark in value, and low in color saturation, whereas an aspen stand in fall could be described as of reddish yellow hue, very light in value (high level of brilliance), with high saturation. The two stands would represent maximum contrasts in all of the significant attributes of color.

Some important relations between color and texture should be mentioned here, although this paper does not attempt to explore detailed effects of their linkage. The textures of broadleaf plants are more reflective and some transmit more light through the crowns than do conifers. Thus, broadleaf plants have a lighter value. Conversely, conifers are less reflective and darker in value than broadleaf plants. Leaf scintillation, as in poplars, increases reflectance and lightens color values. Larger life forms (trees as opposed to shrubs) develop more shade and shadow, contributing to coarseness of texture and to darkening of color value. Soil surfaces, whether revealed by clearing, cultivation, or grading, all have a generally fine texture, which, similar to that of grass, contributes to lighter color value; reflectance and smoothness of surface texture diminish development of shade and shadow.

Both texture and color are affected by distance. Distance makes a profound difference in the appearance of texture. Indeed, the gradation of even texture from coarser to finer is a cue to the perception of distance (Gibson 1950); for example, plowed soil appears finer in the distance.

In a traditional treatment of the subject of plant texture, as applied to landscape design at a project scale, Robinson (1940) indicates that near view texture is dependent first on the size and spacing of leaves and twigs, then on their assembly into boughs, and from these into individual plants. Far view texture is dependent on the massing and arrangement of whole plants. Robinson makes use of the term "texture pattern" as the interplay among different textures, such as fine to coarse contrasts, with modification by light and shade. It is important to distinguish between the relative simplicity that is texture, and the relative complexity (intermixing) of several *textures* that is pattern.

In figure 23 and figure 24, the forest textures are seen relatively close at hand—less than a mile away. The form and scale of individual trees determine a texture that can be called coarse for both conifers and hardwoods (fig. 25); other descriptive modifiers might be wanted. For example, hardwoods may be said to appear soft and conifers harsh because of differences in individual tree outlines.

Corresponding to the texture classes of plant types shown in the diagram in figure 25 is a California coast range example (fig. 26). Coarse, medium, and fine textures are represented respectively by oak and bay woods, chaparral, and grassland. This is a view at relatively close range where texture counts most; it includes zones of foreground (0 to 1 mi) and near middleground (1 to 3 mi) distance. (See Litton 1968 for discussion of zones.)

F-470658

Figure 23—Coarse texture is a visual characteristic of a uniform conifer forest seen close up. (Olympic National Forest, Wash.)

F-478878

Figure 24—Coarse texture is also a visual characteristic of this hardwood forest seen close up. A minor component of conifers is inconspicuous in this summer aspect. (Daniel Boone Forest, Ky.)

In an air photo (fig. 27) with clear atmosphere and visibility range of more than 100 miles, the coarse texture of the subalpine forest at the foot of the near mountain (Three Fingered Jack) is reduced to a smooth, simple tone at a distance of 9 to 10 miles. At such a distance, the reduction of forest texture to a smooth color tone is not immediately perceived; scrutiny is required for this discrimination (Julesz 1975). In another example (fig. 28), through clear air and at a distance of 9 miles, a cutover block with forest residual of about 25 percent canopy cover is discernible within a uniform matrix of 100 percent canopy cover. The color and texture contrast, though minimal, is more readily perceived because the lighter part lies within the single rectangular block shape. If the shape were less than regular or the edges less definite, visual discrimination would call for careful scrutiny. In summary, it appears that coarse texture loses its identity at a distance of 8 to 10 miles when observation conditions are ideal. Shapes, however, because they express color and texture pattern contrasts, can be expected to retain identity beyond a 10-mile distance.

Scrub or chaparral, categorized as having medium texture, can be expected to lose its textural identity within a distance range of 1 to 4 miles. In big sagebrush in Idaho (fig. 29), the texture is diminished to a smooth tone at about a mile and a half. Sagebrush, being of medium light color value—and often in pure stands showing relatively little color contrast with accompanying soils or grass—can be expected to lose textural identity at closer range than chaparral. Although chaparral consists of a highly variable set of species, according to regional adaptation, it tends to be middle gray to medium dark in color value and of a

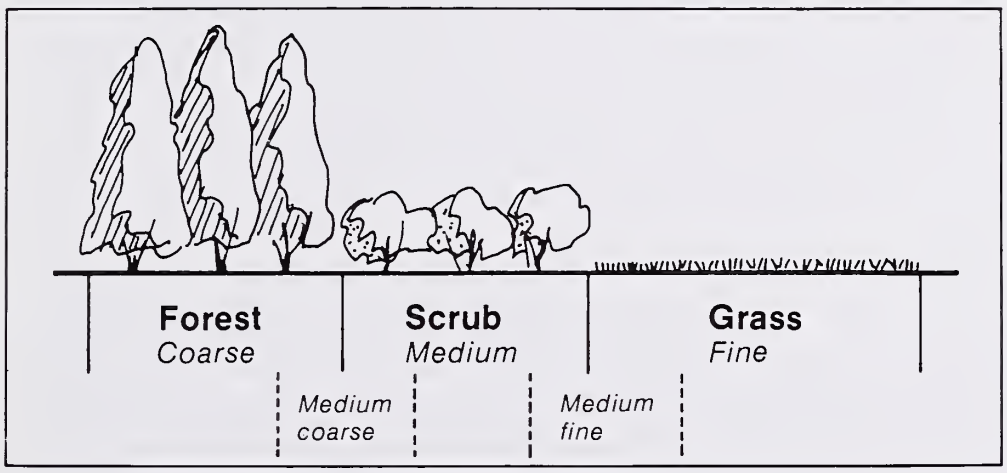

Figure 25—Texture classes are built on lifeforms of plants, their consistency, and repetition.

F-533367

Figure 26—Texture classes seen together show contrast: coarse woods, medium chaparral, fine grassland. (California Coast Range, Big Sur)

F-533368

Figure 27—Distance affects the appearance of texture. Coarse texture seen close-up appears changed to a smooth, textureless tone when seen 9 to 10 miles away. (Willamette National Forest, Oreg.)

F-533369

Figure 28—A selectively cut block with partial canopy is barely perceivable 9 miles distant. The simple shape enhances visual discrimination. (Pickett Peak vicinity, Hayfork, Calif.)

texture ranging from medium to medium coarse. In figure 26, the relatively dark chaparral has distinct texture at a distance of a mile.

Grassland with its fine texture (fig. 30) can show an apparently smooth, textureless color tone at an outside range of 1 mile or as close as one-quarter of a mile. Bunch grass texture should be apparent at the more distant range. In the example, Little Panoche Valley, Calif., the distance is slightly over one-half mile.

Textural classes for surfaces other than vegetation are not specified in this paper, but may readily follow the coarse-medium-fine range used for vegetation types. Examples of different textures of barren mineral surfaces and disturbed surfaces may be seen in figures 6, 15, and 24. As a

F-533370

Figure 29—Big sagebrush scrub, of a medium texture when seen close up, appears as a smooth, textureless tone at about 1½ miles away. (Near Obsidian, Challis National Forest, Idaho)

F-533371

Figure 30—Grassland, of a fine texture when seen close up, appears as a smooth, textureless tone at a range of about one-half mile. (Little Panoche Valley, Calif.)

clue to predicting degree of visual vulnerability relating to textural contrast, note that the disturbed surface of a clear-cut area (see fig. 15) is relatively fine (or smooth) as compared to the coarseness of the surrounding forest—a maximum contrast. Because surfaces resulting from removal of vegetation and soil disturbance tend to appear rather fine in texture, color becomes a stronger element than texture. Yet the two are inseparable.

Distance has as significant an effect on color as it does on texture. Aerial perspective is the perceptual modification of blueness or grayness that affects color in the distance, accompanied by value reduction. (For a discussion in some detail, see Litton 1972.) In brief, colors at foreground distances (arbitrarily 0 to one-quarter to one-half mile, depending on conditions) are seen essentially unchanged; at middleground distances (arbitrarily one-half to 3 to 5 miles), moderate aerial perspective is developed; at background distances (arbitrarily 3 to 5 miles to infinity), aerial perspective is highly developed and actual hues may not be distinguishable.

Vegetation and Soil Color Contrasts

A rough estimate of color value relationships (Litton 1968, p. 18) may be summarized and ranked from light to dark as follows: sky, grassland, scrub, chaparral, forest soils, hardwoods, and conifers. These generalized value differences appear confirmed by a field research study (Litton and Magill 1981) now being conducted on landscape color characteristics. This makes use of the Munsell color system (Munsell 1954, 1972) in determining perceptual contrasts applicable to visual impact prediction (fig. 31).

There are, however, several other hypothetical conditions that may be noted. The colors of scrub, like those of soils, differ considerably according to species and locality. As an example, there is the unusual and marked contrast of big sagebrush and manzanita when the two meet on the Sierra Nevada east side—a middle-gray green against a dark, more vivid green. And, since western shrubs are normally successional after fire or tree cutting, their color and texture contrasts with residual forest are predictable. For visual analysis, familiarity with local plant species should include the ability to interpret their collective color effects.

Apart from color value differences, there are also seasonal chromatic (saturation) differences that are especially conspicuous for grassland, deciduous trees, and scrubland. In grassland, spring vividness—high color saturation—is followed by considerably lower saturation in the other seasons. Some deciduous trees have a seasonal chromatic cycle of greater brilliance spring and fall, with marked reduction of vividness in both summer and winter. Because the interplays between color and texture are difficult to analyze, the relation between color value and chromatic saturation cannot be simplistically separated (fig. 32).

Use of the Munsell color charts for soils and vegetation (plant tissue) for judging color value and chroma (saturation) levels is a recognized procedure, and it is recommended as the obvious way of comparing landscape colors. In order to make a judgment about landscape surfaces with regard to the combination of texture and color, and especially the contrasts between surfaces, the following matrix could be used, based upon a color of particular hue, in which the numerical rankings for value and chroma are taken from Munsell (1972):

Hue (name and number; ex., 5 YR or 5 yellow red)

Texture	*Value*[1]	*Chroma*[1]
1. Fine	2. Dark	2. Weak
2.	3.5	4.
3. Medium	5. Middle gray	6. Medium
4.	6.5	8.
5. Coarse	8. Light	10 Strong

For the conifer and aspen examples cited earlier (figs. 23-25), the comparison would be as follows:

Conifer: Yellowish green hue 5GY, texture 5, value 2, chroma 2.

Aspen: Reddish yellow hue 2.5Y, texture 5, value 8, chroma 8.

Western forest soil colors tend to be of light to middle values, and their significance to visual impacts relates to their disturbance from grading and from removal of screening vegetation. Because soil types are classified partly by color, the effect of the known local soil types on visual vulnerability should be easily recognized. Cut and fill soil surfaces have similar visual impacts initially, but the two demonstrate significantly different persistence over time. Road cuts, as an example, reveal parent rock materials without developed soils and thus discourage native revegetation for long periods of time, especially in drier western climates. Fill surfaces or clearings that include or expose topsoil are revegetated much more quickly than cuts because they provide a reasonable medium for plant growth. The time required for plant regeneration will also be affected by regional climate, and by surface slope and orientation.

At Whiskeytown Lake, Calif., the color contrast of soil with chaparral and the limited reduction of visual impact over a period of 12 years are apparent (fig. 33A and fig. 33B). High road cuts and fill and power corridor clearings with low cuts run through Kidd and Behemotosh soil series (Mallory and others 1973); these soils are described as pale brown to light gray and grayish brown to reddish yellow, respectively. Onsite Munsell soil color chart readings for the visually dominant cuts approximate 7.5 YR 7/4 (hue 7.5 yellow red, value 7, chroma 4). There is signficant color contrast with the surrounding manzanita—scrub oak chaparral, which has onsite color readings of about 5 GY 4/4 (hue 5 green yellow, value 4, chroma 4). In the 12-year period, there is no apparent change in the cut surfaces.

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[1]Numerical ranking based upon Munsell system.

F-533372

Figure 31—Summer color contrasts in aspen and pine are subtle, somewhat similar between conifers and scrub, strongest between grassland and tree types. Textural contrasts maintain similar differences. (Modoc National Forest, Calif.)

F-533373

Figure 32—Dark color of eastern ponderosa and northern floodplain forests shows strong contrast with disturbed soils; hayfields in differing states of growth are also in marked contrast. Pine and scrub are in moderate contrast. (Pompeys Pillar, Yellowstone River, Mont.)

Some road fills have changed from a barren state with extremely open cover (less than 5 percent canopy)[2] to an open cover (20 to 50 percent canopy); other fills show no evidence of change, perhaps because of overcast dumping. The power corridor clearing has changed from open cover (20 to 50 percent canopy) to a dense cover (80 percent or more canopy). This is a harsh site; it is steep, has south orientation, and has a Mediterranean climate with about 6 months of summer drought.

[2]For canopy classes identified by the soil-vegetation study, see Mallory and others 1973.

F-533374

Figure 33A—Road and powerline soil disturbances are highly conspicuous against chaparral, as observed in August 1965. (Whiskeytown Lake Recreation Area, Calif.)

F-533375

Figure 33B—Some soil-vegetation impact contrasts are virtually unchanged in 12 years, others show marked change as observed in June 1977. (Whiskeytown Lake Recreation Area, Calif.)

Shapes

Shapes are discernible and bounded areas of consistent color and texture. Shape edges vary, however, from distinct to very indistinct. (See following discussion of "Edges.") In an analytical overview of the landscape, shapes may be perceived as two-dimensional, whether they consist of scree, water, grass, scrub, or trees. A grassland shape within forest surroundings is clearly three-dimensional and may be experienced first hand as a space; but seen at a distance, the combination becomes a part of a two-dimensional mosaic pattern (fig. 34). Some shapes may be simple configurations, readily described as circular, elliptical, rectangular, triangular, or linear. More commonly, simple configurations are combined into complex shapes and their description may be excessively difficult. If complex shapes within the visual field of a broad mosaic defy description, it may be more useful to identify proportions of different surface materials, that is, one-third grassland, two-thirds woodland. Another definitive approach is to make a graphic overlay over a photograph (fig. 35A) to represent shapes and relationships, rather than depend on strict verbal description. Description and representation of repeated shapes help to identify compositional elements that are visually typical of local surface patterns. When this analytical understanding has been achieved, such resource manipulations as timber cutting, type conversions, and road or power corridor alinements can be guided to fit and reflect identified surface patterns.

Brief reflection will suggest why visible shapes in either the general landscape mosaic or the more specific plant mosaic are complex and variable. Sources of such shapes and influences include combinations of landform facets, terrain slope variations, orientation, climate and microclimate, geological base, soil development, moisture availability, water bodies, vegetation succession stage, seed or vegetative regeneration sources, fire, insects, diseases, wildlife activities, and activities of people.

In the grassland-woodland mosaic example (fig. 35B) three different kinds of vegetation shapes make up the overall surface pattern. Edges between shapes vary from distinct to vague. Included are grassland shapes of fine texture and light color value; heavy-density, continuous-canopy woodland shapes of coarse texture and dark value; and medium-density woodland shapes, which may be called *subordinate pattern* shapes because they combine grassland (fine texture, light value) with variably open-spaced trees (coarse texture, dark value). Predominant factors affecting this particular surface pattern are terrain facets, climate, orientation, and moisture availability.

In the drawing (fig. 35B), the following kinds of shapes are identified: 6 of grassland (each roughly rectangular), 6 of heavy density woodland (some roughly rectangular, some triangular), and 12 of medium density woodland (variably and roughly rectangular, triangular, and semicircular). Relative size (scale) of vegetation shapes may be determined and also locations with respect to landforms. Repetition within the several kinds of vegetation shapes

F-533376

Figure 34—Grassland shapes within spruce-fir forest make a strong visual pattern. (Bighorn National Forest, Wyo.)

F-533377

Figure 35A—California oakwoods-grassland pattern shows particular response to exposure, moisture, and soil factors. (Coast Range-Cortina Ridge, Colusa Co., Calif.)

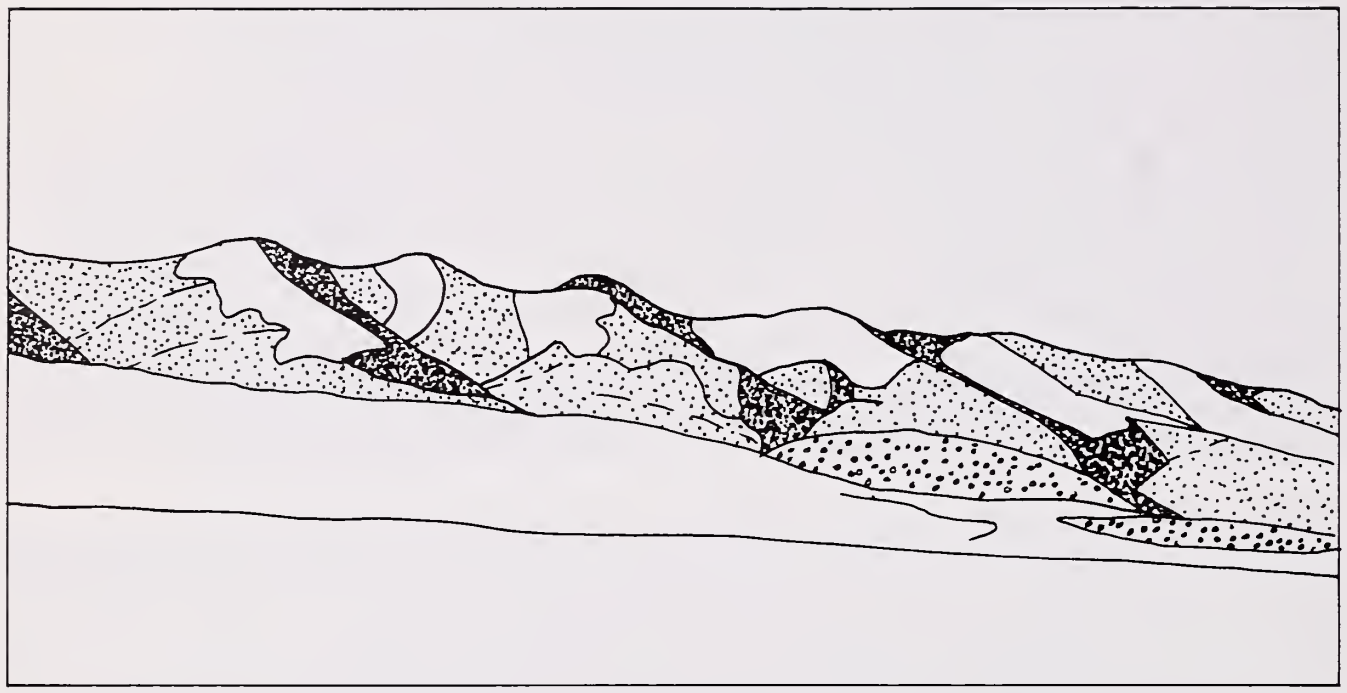

Figure 35B—The California oakwoods-grassland mosaic pattern within a visual field may be portrayed as a diagram in lieu of other description.

reflects scale and shape similarities tied to the individual facets of regionally typical landforms. Another and more general characterization of this surface pattern would specify the proportions of components: about one-sixth (15 percent) heavy density woodland, about one-fourth (25 percent) grassland, and about two-thirds (60 percent) medium-density woodland. In another very different example of mosaic shapes, shown in figure 31, note the predominately elongated grass and aspen shapes.

Impacts of resource management activities are most apt to be noticeable because new shapes are made by clearing and grading, and these may deviate, especially in shape, from the compositional elements of native surface patterns. The visual vulnerability of the landscape mosaic may be ranked highest where pattern is lacking or indistinct and lowest where pattern is conspicuous and complex. Some of the figures already presented provide a ranking example, from higher to lower:

1. No pattern is apparent in this close-in view; the search for pattern will require larger area coverage (fig. 23).
2. Subtle vegetation pattern is seen in forest stand variations; upland mineral pattern shapes are apparent (fig. 27).
3. Lowlands pattern is apparent, but forest uplands pattern is more subtle; human-caused pattern changes are significant (fig. 20).
4. Strong pattern is discernible where grassland shapes dominate; pattern is more subtle in the woodlands (fig. 35).

Relating new shapes to the native shapes of surface pattern is a basic means of controlling visual impact. It can be done only with adequate documentation and analysis of the original surface pattern. Visual analysis of native shapes can include identification of shape types or configurations, their scale or relative sizes, their relation to topography and to landform orientation, their edges, and the color contrasts between shapes and surrounding matrix.

Edges

The visual distinction between vegetation mosaic shapes depends on their color and texture characteristics and their

edges. This kind of distinction in the landscape is also affected by scale and distance; it is a resolution problem. Mosaic shapes of larger scale seen from a distance can be distinguishable even though their edges may have the fuzziness of a graduated transition zone between two different surface materials. Mosaic shapes of smaller scale seen close at hand are more vague if their edges are not sharp. Julesz' experiments with texture (1975) indicate that contrasts can be perceived without effort if different textures are within bounded areas, creating simple shapes, or if any abut one another with a sharp edge. In vegetation, edge contrasts are also built on contrasts of plant life form or color and texture. If we ignore the detail of particular species differences within individual life-form classes, we can draw up a list of estimated contrasts in vegetation life-form types affecting mosaic edges, ranked from higher to lower:

1. Conifers, upland hardwoods: Grass
2. Riparian hardwoods : Grass
3. Scrub : Grass
4. Conifers, upland hardwoods: Scrub
5. Conifers, upland hardwoods: Riparian hardwoods, deciduous conifers
6. Conifers : Upland hardwoods, deciduous conifers
7. Hardwoods : Other hardwood species
8. Conifers : Other conifer species
9. Scrub : Other scrub species
10. Grass : Other grass species

From a generalized list like this, it is recommended that rankings be determined empirically for the specific plant communities that are locally typical. The ranks 7 through 10 above represent very subtle contrasts, which especially need interpretation to suit local conditions.

Native vegetation edges are ecotones that respond to environmental conditions. Artificial edges result from timber cutting, type conversions, or agricultural and right-of-way clearings.

By their visual characteristics, four different kinds of edges can be identified and ranked for their relative distinctiveness. They are butt edges, interfingered butt edges, stepped ramp or buffered edges, and gradually blended or feathered edges. As ecotones, these represent only two classes: abrupt and gradual (Daubenmire 1968); the first three are abrupt and the fourth gradual—a zonal change within a continuum. The four kinds of edges are shown diagrammatically in figure 36.

Four photos (fig. 37, fig. 38, fig. 39, and fig. 40) present examples of both natural and artificial edges. The measure of visual vulnerability should be the degree of conformity shown by the edges of the modified area with edges characteristic of the local landscape. Butt edges are perhaps the most common kind resulting from artificial changes, and are the most obvious of edges. Yet butt edges are common enough in nature and should accordingly serve as appropriate models for changes as their configuration is guided by shapes that are present in the native surface pattern. Diffused or feathered edges, typical of woodlands, are logical models only if surrounding landscape mosaics suggest it. They should not be arbitrarily adopted merely because they may deemphasize edge clarity.

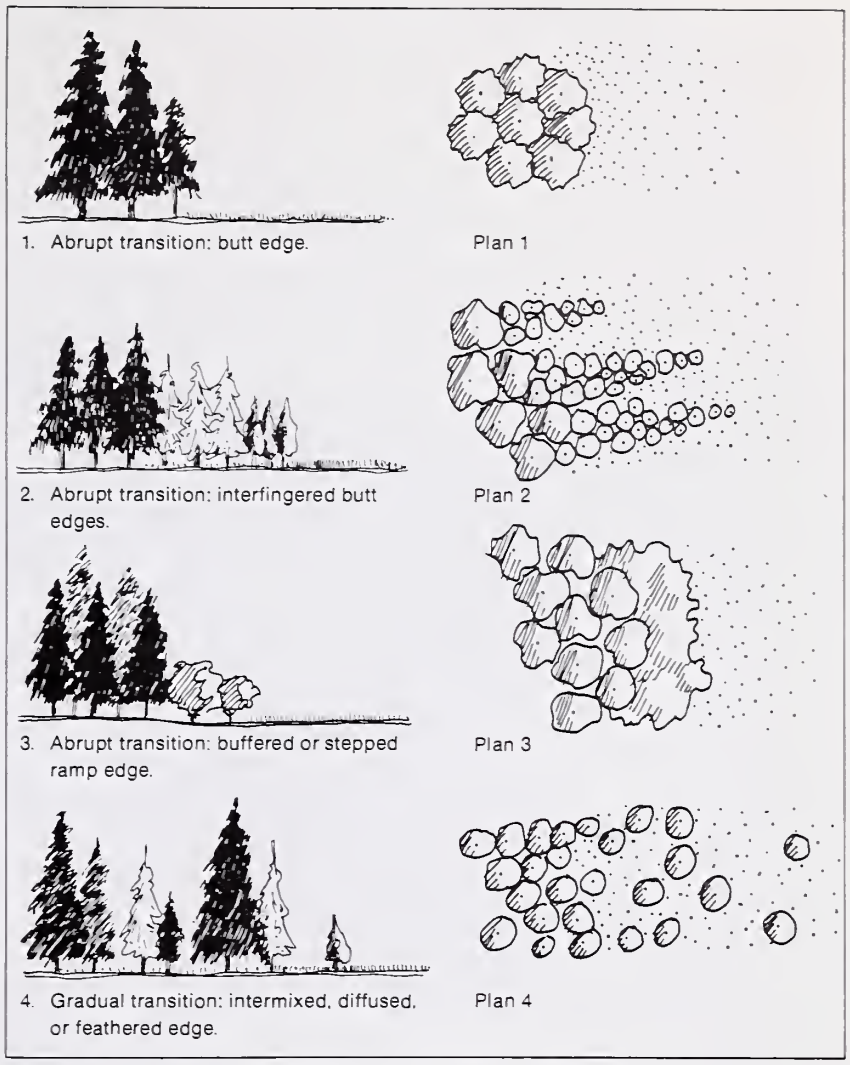

Figure 36—Four kinds of visual edges are ranked in order of diminishing distinction.

In summary, surface patterns and their relation to visual vulnerability of the landscape have been treated here primarily in terms of the vegetative mosaic and soil colors. Textures, colors, shapes, and edges are discrete parts of surface pattern. A single texture is one having a generally homogeneous appearance based on repeated similar forms and spacings. A complex of textures, colors, and shapes, which occurs more commonly than a single texture, creates a pattern. Textures are categorized as coarse, medium, and fine; dissimilar textures seen together are part of overall pattern. Color varies according to hue, value, and saturation; relative contrasts can be systematically examined through use of the Munsell color system. Apparent texture and color are both materially altered by distance and by time. Shapes are those discernible, bounded areas of consistent color and texture; a set of shapes together also contribute to pattern. Edges of several types are identified and discussed according to the degrees of distinction or indistinction they give to vegetative shapes. These several attributes of surface patterns may be seen to play different, but identifiable, roles in prediction of visual vulnerability.

For proper use, the analytics developed here should be related to the typical landforms and surface patterns indigenous to a particular region or locality. Only in that way can more specific and reliable predictors of visual vulnerability contribute to better landscape planning, design, and management.

F-477944

Figure 37—Natural butt edges. (Bighorn National Forest, Wyo.)

F-533378

Figure 38—Butt edges from timber cutting. (Olympic National Forest, Wash.)

F-513241

Figure 39—Natural buffered or stepped ramp and butt edges. (Mendocino National Forest, Calif.)

F-533379

Figure 40—Natural interfingered butt and diffused feathered edges. (Inyo National Forest, Calif.)

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Visual vulnerability is defined as the landscape's inherent resistance or susceptibility to degrading visual impacts. From 10 elements of landforms and surface patterns, seen as visual attributes of the landscape, the magnitude of potential change can be predicted before specific sources of impact, such as timber cutting and roadbuilding, are known. Landform analysis elements include profiles or silhouettes, various surface slope categories and related visual surface areas, and various landform segments and edges and their locations. Elements of surface pattern analysis, particularly the vegetative mosaic, include texture, color, distance, shapes, and edges. For the selected visual impact predictors reported on, qualitative definitions and relative weighting or ranking of factors are emphasized.

KEYWORDS: Visual impact, impact prediction, landscape design, landscape management and planning, visual vulnerability, environmental planning